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Bibliography.

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Summary.

(57) [Abstract]
[Technical problem] The manufacture method of an ink-jet recording head of having abolished the variation in opening of the ink feed hopper by anisotropic etching is offered.
[Means for Solution] The manufacture method of an ink-jet recording head including the process which forms **** 10 in the field by the side of reverse (upper surface) beforehand by sandblasting, dry etching, etc., carries out anisotropic etching of the substrate 1 (undersurface) to the field as for which a substrate 1 carries out anisotropic etching so that this **** 10 may be penetrated, and forms the ink feed hopper 9.

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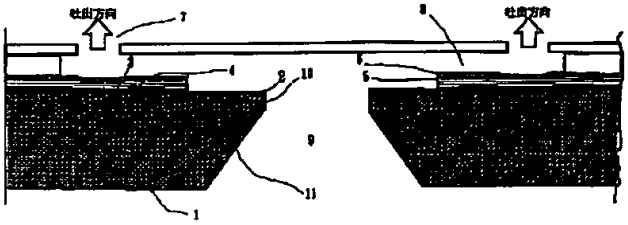

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CLAIMS

[Claim(s)]
[Claim 1] The manufacture method of the ink-jet recording head characterized by providing the following. It is a **** energy generation element on the aforementioned substrate including the process which carries out anisotropic etching of the substrate and forms the hole for ink feed hoppers. The liquid route for making the energy from this **** energy generation element act on ink. The field as for which this substrate carries out anisotropic etching before carrying out anisotropic etching of the aforementioned substrate in the manufacture method of an ink-jet recording head of having the delivery of the ** sake which breathes out the ink on which this energy acted, and having the aforementioned ink feed hopper for supplying ink to this liquid route in the aforementioned substrate is the process which forms the crevice in the field by the side of reverse beforehand, carries out anisotropic etching of the aforementioned substrate, and forms the hole for the aforementioned ink feed hoppers so that this crevice may be penetrated.
[Claim 2] The aforementioned crevice is the manufacture method of the ink-jet recording head according to claim 1 which is a **** configuration.
[Claim 3] The manufacture method of an ink-jet recording head according to claim 1 or 2 that sandblasting or dry etching performs the aforementioned crevice.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the method of carrying out anisotropic etching of the substrate and forming the hole for ink feed hoppers in more detail about the manufacture method of an ink-jet recording head.
[0002]
[Description of the Prior Art] A heat ink-jet recording method is a method which an exoergic resistor is made to generate heat through current, is made to generate a bubble in ink by this, tells the energy of this bubble

to the ink in a narrow nozzle (liquid route), and carries out the regurgitation of the ink drop from a delivery. About the discharge direction of this ink drop, there is a thing of the method which carries out the regurgitation in parallel to an exoergic resistor, and the method which carries out the regurgitation perpendicularly to an exoergic resistor.

[0003] Such a manufacture method of an ink-jet recording head consists of the membrane formation process and FOTORISO process over substrates, such as a silicon wafer, a nozzle formation process, a mounting process, etc.

[0004] Drawing 4 is the typical cross section showing the fundamental composition of the conventional ink-jet recording head. On the substrate 1 which consists of a silicon wafer etc., the head shown in this drawing has the insulating accumulation layer 2 which consists of a thermal oxidation film etc., and has the exoergic resistor layer 3, the electrode wiring layer 4, the ink-proof layer (the first protective layer) 5, and cavitation-proof film (second protective layer) 6 grade in order on it. These are all the thin films by which were formed by the sputtering method etc. and patterning was carried out with photolithography etc. In addition, the cavitation-proof film 6 is a protective coat for preventing the damage of the front face of the exoergic resistor layer 3 produced when the bubble which finished conducting heat energy carries out defoaming.

[0005] Furthermore, a nozzle (liquid route 8) is formed in this, a canopy is formed or joined, it connects by wire bonding or TAB, and electrical signal connection with the exterior is made a heat ink-jet recording head.

[0006] In this heat ink-jet recording head, supply ink to a liquid route 8 from the ink feed hopper 9 prepared in the substrate, and the exoergic resistor layer 3 is made to generate heat, a bubble is generated in ink and the regurgitation of the ink drop is carried out from the delivery 7 which this prepared at the canopy.

[0007] In addition, a heat ink-jet recording head is divided into an exoergic resistor, the thing which carried the aforementioned drive controlling element on the same substrate in which electrode wiring was formed, and the thing which formed only an exoergic resistor and electrode wiring on the substrate, considered the driver for drive control as another chip, and connected this by wire bonding or TAB junction.

[0008]

[Problem(s) to be Solved by the Invention] In the conventional method shown in drawing 4 , the ink feed hopper 9 is usually processed by anisotropic etching. This anisotropic etching has risk of affecting the electrode wiring layer 4 and a nozzle wall, when the repeatability of processing is low and **********s near the liquid route 8 side. Therefore, a margin is expected beforehand and anisotropic etching is performed so that such over etching may not arise.

[0009] However, when expecting a margin and **********ing, opening of the ink feed hopper 9 becomes small, and there is [**** / not carrying out opening, when worst] a case where opening is not partially carried out by the crystal defect of a substrate as shown in drawing 5 , plentifully.

[0010] On the other hand, in order to raise refill frequency in such a recording head, it is necessary to carry out near of the distance of the liquid route 8 with the exoergic resistor layer 3, and the ink feed hopper 9 as much as possible. This refill means that ink is full a liquid route 8 and near delivery 7 of the whole again after the ink regurgitation, and this refill time has big influence on the printing speed of a printer. That is, if a refill does not catch up even if it carries out drive frequency early, the exoergic resistor layer 3 generates heat in a state without ink, or the state with little ink, and since there is little non-regurgitation of ink or discharge

quantity of ink, printing will become indistinct.
[0011] In order to raise this refill frequency, it is necessary to carry out near of the distance of the liquid route 8 with the exoergic resistor layer 3, and the ink feed hopper 9 which supplies ink to a liquid route 8 as much as possible. However, it is difficult to fully carry out near of the distance of a liquid route 8 and the ink feed hopper 9 by etching which expected the margin as mentioned above.
[0012] By abolishing the variation in opening of the ink feed hopper by anisotropic etching, this invention stabilizes reduction of a percent defective, and the refill time between nozzles, and aims at offering the method that the good ink-jet recording head of printing grace can be manufactured.
[0013]
[Means for Solving the Problem] this invention on the aforementioned substrate including the process which carries out anisotropic etching of the substrate and forms the hole for ink feed hoppers A regurgitation energy generation element, The liquid route for making the energy from this regurgitation energy generation element act on ink, In the manufacture method of an ink-jet recording head of having a delivery for carrying out the regurgitation of the ink on which this energy acted, and having the aforementioned ink feed hopper for supplying ink to this liquid route in the aforementioned substrate Before carrying out anisotropic etching of the aforementioned substrate, the field as for which this substrate carries out anisotropic etching is the manufacture method of an ink-jet recording head including the process which forms the crevice in the field by the side of reverse beforehand, carries out anisotropic etching of the aforementioned substrate, and forms the hole for the aforementioned ink feed hoppers so that this crevice may be penetrated.
[0014] In this invention, before carrying out opening of the ink feed hopper, **** (crevice formation) is performed on the wafer front face of the opposite side which performs anisotropic etching beforehand, and the feed hopper of anisotropic etching is opened there, for example. That is, it is ** for carrying out opening, since there is this **** even when anisotropic etching is performed and it does not carry out opening by underetching conventionally.
[0015]
[Embodiments of the Invention] Hereafter, the suitable operation gestalt of this invention is explained.
[0016] Drawing 1 is the typical cross section showing 1 operation gestalt of this invention. It has the insulating accumulation layer 2 which consists of a thermal oxidation film etc. in this example on the substrate 1 which consists of a silicon wafer etc. On it in order It has the cavitation-proof film (second protective layer) 6 grade which consists of an ink-proof layer (the first protective layer) 5 which turns into the exoergic resistor layer 3 for constituting a regurgitation energy generation element (exoergic resistor), and this exoergic resistor layer 3 from the electrode wiring layers 4, such as aluminum which supplies power, SiN, etc., Ta, etc. These are all the thin films by which were formed by the sputtering method etc. and patterning was carried out with photolithography etc.
[0017] Furthermore, a nozzle (liquid route 8) is formed with a canopy and a nozzle wall, and the ink feed hopper 9 which consists of **** 10 and an anisotropic etching side 11 is formed in the substrate 1.
[0018] Hereafter, order is explained for each process of the manufacture method in this operation gestalt later on.
[0019] First, the insulating accumulation layer 2 which consists of an oxide film etc. is formed on the substrate 1 which consists of a silicon wafer etc. This may be formed by the sputtering method etc. and may

form a thermal oxidation film in a silicon wafer. Moreover, the exoergic resistor layer 3 is formed by the sputtering method etc. Furthermore, on it, the electrode wiring layers 4, such as aluminum, are formed by the sputtering method etc. Subsequently, patterning of the exoergic resistor layer 3 is further carried out for the electrode wiring layer 4 with photolithography. And the ink-proof layer 5 which consists of SiN etc. on it is formed by the sputtering method etc., and the cavitation-proof film 6 grade which consists of Ta etc. is formed further.

[0020] Subsequently, the ink feed hopper 9 is formed in a substrate 1. Drawing 2 (a) and (b) are the typical cross sections showing the formation process of the ink feed hopper 9 in this operation gestalt. First, before carrying out anisotropic etching of the substrate 1, as shown in drawing 2 (a), with the field as for which a substrate carries out anisotropic etching, the crevice of the desired depth and desired width of face is beforehand formed in the field by the side of reverse (field in which each class 2-6 was formed). Although especially the method of forming this crevice is not restricted, **** by sandblasting, dry etching (CDE), etc. can apply it suitably, for example.

[0021] Next, a liquid route 7 and a delivery 8 are formed, power wiring is connected, and it considers as a heat ink-jet recording head. You should just adopt the same process as usual after these nozzle formation process. In addition, although the elements for drive control (a power transistor, logical circuit, etc.) were considered as the external type, you may make from this operation gestalt for this chip.

[0022] Since ****** absorbs, and the opening width of face on a front face is done by fixed width of face and it can fully carry out near of the distance of a liquid route 8 and the ink feed hopper 9 even if the width of face of opening of the circumference of an ink feed hopper produced by the above-mentioned method has the crystal defect of a wafer etc., it can also raise refill frequency.

[0023] Especially, also in an ink-jet recording method, this invention forms a flight drop using heat energy, and brings about the effect which was excellent in the recording head of the ink-jet recording method which records, and the recording device.

[0024] About the typical composition and typical principle, what is performed using the fundamental principle currently indicated by the U.S. Pat. No. 4723129 specification and the 4740796 specification, for example is desirable. Although this method is applicable to both the so-called on-demand type and a continuous system On the electric thermal-conversion object which is especially arranged corresponding to the sheet and liquid route where the liquid (ink) is held in the on-demand type case By impressing at least one driving signal which gives the rapid temperature rise which corresponds to recording information and exceeds nucleate boiling Since make an electric thermal-conversion object generate heat energy, the heat operating surface of a recording head is made to produce film boiling and the foam in the liquid (ink) corresponding to this driving signal can be formed by the one to one as a result, it is effective. A liquid (ink) is made to breathe out through opening for regurgitation by growth of this foam, and contraction, and at least one drop is formed. If this driving signal is made into the shape of a pulse form, since growth contraction of a foam will be performed appropriately instancy, the regurgitation of a liquid (ink) excellent in especially responsibility can be attained, and it is more desirable.

[0025] As a driving signal of the shape of this pulse form, what is indicated by the U.S. Pat. No. 4463359 specification and the 4345262 specification is suitable. In addition, if the conditions indicated by the U.S. Pat. No. 4313124 specification of invention about the rate of a temperature rise of the above-mentioned heat

operating surface are adopted, further excellent record can be performed.

[0026] The composition using the U.S. Pat. No. 4558333 specification and U.S. Pat. No. 4459600 specification which indicate the composition arranged to the field to which the heat operation section other than the combination composition (a straight-line-like liquid flow channel or right-angled liquid flow channel) of a delivery which is indicated by each above-mentioned specification as composition of a recording head, a liquid route, and an electric thermal-conversion object is crooked is also included in this invention.

[0027] In addition, this invention is effective also as composition based on JP,59-138461,A which indicates the composition whose puncturing which absorbs the pressure wave of JP,59-123670,A which indicates the composition which makes a common slit the regurgitation section of an electric thermal-conversion object to two or more electric thermal-conversion objects, or heat energy is made to correspond to the regurgitation section.

[0028] Furthermore, although any of the composition which fills the length with the combination of two or more recording heads which are indicated by the specification mentioned above as a recording head of the full line type which has the length corresponding to the width of face of the maximum record medium which can record a recording device, and the composition as one recording head formed in one are sufficient, this invention can demonstrate the effect mentioned above much more effectively.

[0029] In addition, this invention is effective when the recording head of the exchangeable chip type with which the electric connection with the main part of equipment and supply of the ink from the main part of equipment are attained, or the recording head of the cartridge type with which the ink tank was formed in the recording head itself in one is used by the main part of equipment being equipped.

[0030] Moreover, it is a book to add the recovery means against a recording head established as composition of the recording device of this invention, preliminary auxiliary means, etc. It is effective in order to perform record stabilized by performing reserve regurgitation mode in which the preheating means by the capping means, the cleaning means, the pressurization or the suction means, the electric thermal-conversion object, the heating elements different from this, or such combination over a recording head and the regurgitation different from record are performed, if these are mentioned concretely.

[0031] Furthermore, as a recording mode of a recording device, not only the recording mode of only mainstream colors, such as black, but a recording head is constituted in one, or although it is good even by combination in plurality, this invention is very effective also in equipment equipped with full color at least one by the double color color of a different color, or color mixture.

[0032] In this invention example explained above, although ink is explained as a liquid The thing which is ink solidified less than [a room temperature or it], and is softened at a room temperature, or the thing which is a liquid, Or by the above-mentioned ink-jet method, since what carries out a temperature control is common as a temperature control is performed for ink itself within the limits of 30 degrees C or more 70 degrees C or less and it is in the stable regurgitation range about the viscosity of ink, ink should just make the shape of liquid at the time of use record signal grant.

[0033] In addition, it carries out whether the ink which prevents by making the temperature up by heat energy use it positively as energy of the change of state from the solid state of ink to a liquid state, or is solidified in the state of neglect for the purpose of antiflashing of ink is used. Anyway, ink liquefies by grant according to the record signal of heat energy. Use of the ink of the property liquefied for the first time with

heat energy, such as what carries out the regurgitation as liquefied ink, and a thing which it already begins to solidify when reaching a record medium, is also applicable to this invention. In such a case, ink is good for a porosity sheet crevice or a breakthrough which is indicated by JP,54-56847,A or JP,60-71260,A also as liquefied or a gestalt which counters to an electric thermal-conversion object in the state where it was held as a solid. In this invention, the most effective thing performs the film-boiling method mentioned above to each ink mentioned above.

[0034]

[Example] Hereafter, the example of this invention is explained.

[0035] <Example 1> The insulating accumulation layer 2 which consists of a thermal oxidation film with a thickness of 3.0 micrometers was first formed on the substrate 1 which consists of a silicon wafer. The exoergic resistor layer 3 which consists of HfB2 on it was formed by the sputtering method. Furthermore, on it, the electrode wiring layer 4 which consists of aluminum was formed by the sputtering method. Subsequently, patterning of the exoergic resistor layer 3 was further carried out for the electrode wiring layer 4 with photolithography. And the ink-proof layer 5 which consists of SiN on it was formed by the sputtering method, and the cavitation-proof film 6 which consists of Ta was formed further.

[0036] Next, although opening of the ink feed hopper 9 was carried out, the opening width of face was set to 140 micrometers, and it is sandblasting, and as shown in drawing 2 (a), it ****(ed) 140 micrometer width of face of partial which carries out opening beforehand. The depth was set to 50 micrometers. It asked for these 50 micrometers as follows.

[0037] First, anisotropic etching was actually performed several times and the amount of over etching was calculated. This amount of over etching has measured the amount of underetching as 0 micrometer, and side etching turns into only over etching. Consequently, the amount of the maximum over etching was 36 micrometers at one side. Since the calculated amount of over etching is the maximum, the actual amount of over etching does not become larger than this. Therefore, the width of face which actually carries out opening to opening of an ink feed hopper becomes small. The amount which becomes small became 36 micrometers of one side at the maximum, and when calculating the depth of **** in consideration of this amount shifted 36 micrometers, it was set to 50 micrometers.

[0038] this calculation method -- the mask opening width of face (wafer width of face) of anisotropic etching -- 950 micrometers -- carrying out -- ink feed-hopper opening width of face -- the amount of over etching nothing, and a wafer -- thick -- it asked for the etching angle of a= 55 degrees (refer to drawing 3) as 625 micrometers, and it asked for **** depth b, having used the amount of the maximum over etching as 36 micrometers next As a result, it is set to about 51 micrometers. If the error of the **** depth is taken into consideration, it will not interfere as 50 micrometers.

[0039] Next, like the conventional method, the nozzle (liquid route 8) and the delivery 7 were formed, power wiring was connected, and the heat ink-jet recording head was obtained.

[0040] Thus, in the produced recording head, even if the width of face of opening of the circumference of the ink feed hopper 9 had the crystal defect of a wafer etc., this ****** absorbed, the opening width of face on a front face is fixed width of face, and printing grace of a completion printing examination was improving conventionally as compared with elegance.

[0041] Except having adopted the dry etching (CDE) which used the chemical dry etching system as the

method of <example 2> ****, when the heat ink-jet recording head was produced like the example 1, the same good result as an example 1 was obtained.

[0042]

[Effect of the Invention] According to this invention, as explained above, even if there is variation in the anisotropic etching by the crystal defect in a wafer, the size in which an ink feed hopper actually carries out opening becomes fixed with each [in a wafer] chip, and the variation in opening of the ink feed hopper by anisotropic etching can be abolished. By this, opening is not carried out, or the defect that width of face is small dies, the rate of an excellent article improves, and it leads to a cost cut.

[0043] Moreover, since the width of face of opening becomes fixed, the variation in the refill time between nozzles decreases, and printing grace improves.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the typical cross section showing 1 operation gestalt of this invention.

[Drawing 2] (a) and (b) are the typical cross sections showing the formation process of the ink feed hopper in this operation gestalt.

[Drawing 3] It is drawing for explaining how asking for the depth size of **** in an example.

[Drawing 4] It is the typical cross section showing the fundamental composition of the conventional ink-jet recording head.

[Drawing 5] It is drawing showing the ink feed-hopper section cross section at the time of the underetching in the conventional technology.

[Description of Notations]

1 Substrate

2 Insulating Accumulation Layer

3 Exoergic Resistor Layer

4 Electrode Wiring Layer

5 Ink-proof Layer (First Protective Layer)

6 Cavitation-proof Film (Second Protective Layer)

7 Delivery

8 Liquid Route

9 Ink Feed Hopper

10 ****

11 Anisotropic Etching Side

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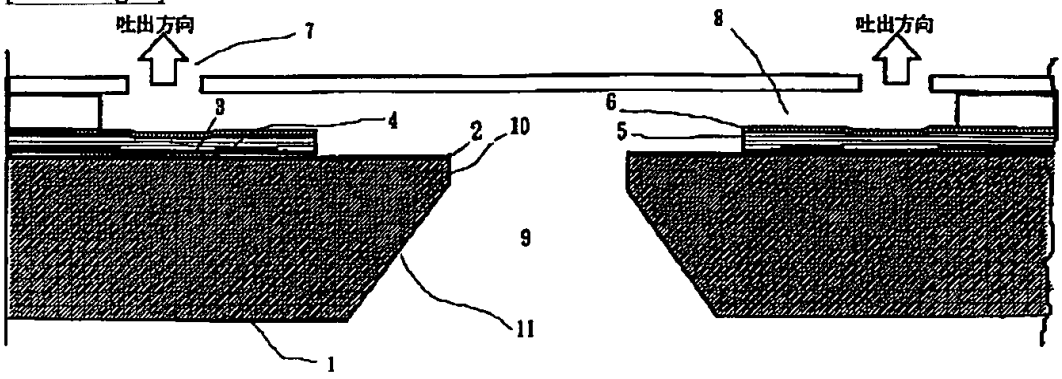
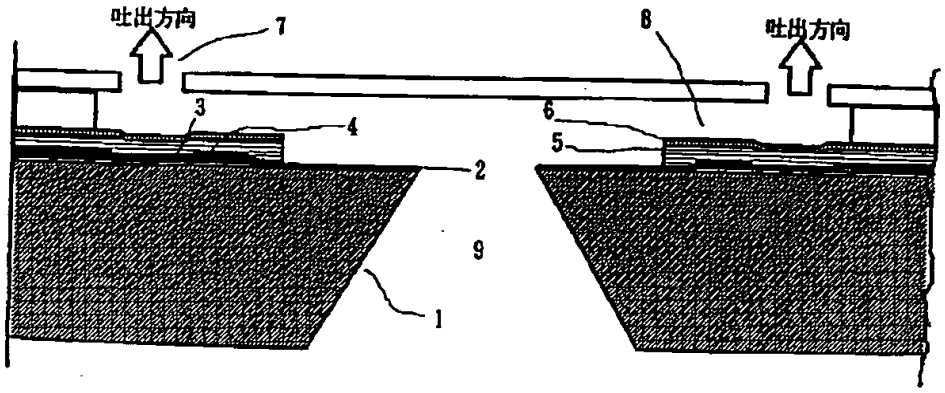
DRAWINGS

[Drawing 1]

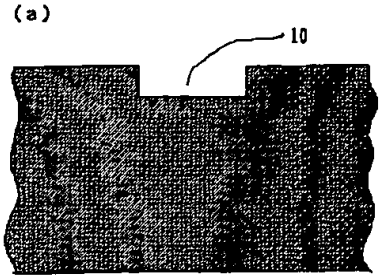


[Drawing 4]



[Drawing 2]

(a)



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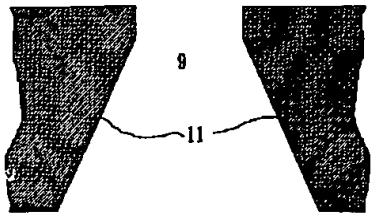

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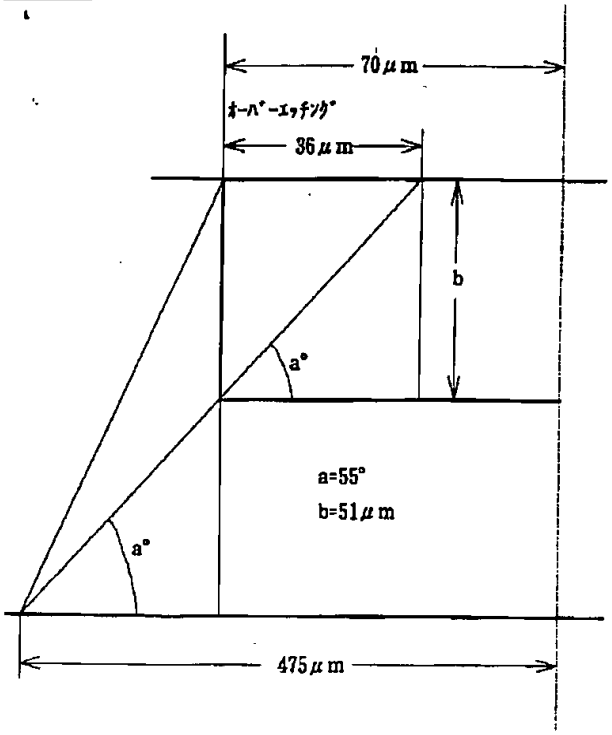

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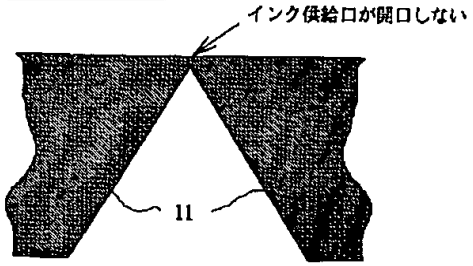
[Drawing 5]



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